CHAPTER 6
OPERATION OF TWGSS
LESSON PLAN 6

METHOD:

Conference, demonstration, and practical exercise

TIME ALLOTTED:

3.0 hours

COURSE PRESENTED TO:

a. Tank crews
b. Instructors
c. TSC personnel

TOOLS, EQUIPMENT, AND MATERIALS:

See Appendix A

PERSONNEL:

a. Primary instructor
b. Assistant instructor

INSTRUCTIONAL AIDS:

a. Overhead projector
b. Viewgraphs (Appendix E)

REFERENCES:

a. TM 9-6920-709-12&P-1-2, Chapter 2
b. TM 9-2350-288-10-1/2
c. ST 17-12-1-A2, Chapter 16

APPENDICES:

Appendix A. Tools, Equipment, and Materials
Appendix B. Safety
Appendix C. TDRS Memory Card Setups
Appendix D. Setup of Training Area
Appendix E. Viewgraphs

6-1. INTRODUCTION. (5 minutes)

Note. Show Slide 1.

a. **Reason**. TWGSS is designed to provide tank crews with a training device to conduct precision gunnery training. To use TWGSS to its full potential, you must know how to operate TWGSS in the various training modes.

Note. Show Slide 2.

b. **Training Objective**. Given an operational M1A2 tank with TWGSS installed and aligned, the crew will conduct the following exercises:

(1) Panel gunnery
(2) Combat mode (force-on-force)
(3) Tracking training

c. **Procedure**. During this block of instruction we will cover operation of TWGSS during training. The classroom portion of the class will cover important functions of TWGSS to consider during training. Each tank crew will have an assistant (small group) instructor for the practical exercise portion of this class.

6-2. CONFERENCE/DEMONSTRATION/PRACTICAL EXERCISE. (160 minutes)

Notes. 1. The primary instructor will release the student crews to their assigned assistant (small group) instructors for the practical exercise portion of this lesson.
2. Show Slide 3.

a. **TWGSS Training Modes.** TWGSS provides several modes of training that can be used for various types of exercises. The following training modes can be selected:

(1) **Panel gunnery.** This mode of training is conducted with target panels equipped with retro reflector units and LTIDs.
(2) **Combat mode (force-on-force).** This training mode can be done with other TWGSS/PGS/MILES-equipped tanks and retro reflector units.
(3) **Tracking training.** The system provides manipulation training with the use of tracking training mode.

Note. Show Slide 4.

b. **Transparency During Training.** TWGSS is designed to be fully integrated with the tank. The tank crew is required to perform the same procedures as required during live fire gunnery.

Note. Show Slide 5.

6-2. CONFERENCE/DEMONSTRATION/PRACTICAL EXERCISE (Con't).

(1) **Laser rangefinder (LRF) simulation.**

(a) LRF with TWGSS. TWGSS provides the crew with the capability to train with the filtered rangefinder of the tank to determine range.

Notes. 1. During M1A2 TWGSS training, the filtered LRF mode (TANK LRF) is the only mode available. TWGSS LRF shall not be selected during training.
2. TWGSS automatically selects tank LRF after TWGSS or tank power is off.
3. Show Slide 6.

(2) **Loader's function.** The loader must use the loader's panel to select the ammunition desired and to simulate the loading of a main gun round. For additional training, a dummy round can be loaded.

Note. Show Slide 7.

c. **TBOS Effects.** Visual effect of firing the main gun and coax are simulated in the GAS and GPS day and thermal mode. The effects simulated are:

(1) **Tracer simulation.** The tracer of the main gun round and every fifth coax round are simulated in GPS and GAS sights. The correct burn time of each ammunition type is pre-programmed.
(2) **Burst simulation.** Burst on target and ground burst are simulated. Ground burst effects are smaller than target hit burst effects. The burst size is ammunition and range dependent.
(3) **Obscuration.** The obscuration of firing the main gun is simulated in GPS and GAS sights. The instructor can adjust the duration from 0-6 seconds.

Note. Show Slide 8.

d. **Tracer Template.** The visual effects of the TBOS simulation are controlled by a template. The following happens with TBOS effects when firing in the different areas.

Note. The template is a T80 frontal for main gun and a kneeling soldier for coax.

(1) **Area A.** If area A is hit, tracer simulation is stopped. A burst on target indication is given. Burst on target indication is bigger than burst on ground indication.
(2) **Area B**. If area B is hit, tracer simulation is stopped prior to reaching target and burst on ground indication is given at the impact point between projectile and a simulated ground plane.

(3) **Area C.** If area C is hit, tracer simulation continues until the simulated projectile reaches maximum simulated range (if this happens prior to a ground hit) or hits the simulated ground plane.

(4) **Area D.** If area D is hit, tracer simulation stops at the top of the template or simulation continues (with the tracer simulation switched off) until the ammunition reaches maximum simulated range or hits the simulated ground plane.

Note. Show Slide 9.

e. **Ammunition Simulation.** The ammunition of the main gun and coax are simulated to the following ranges:

(1) Main gun ammunition is simulated to 3750 m.
(2) 7.62mm coax ammunition is simulated to 900 m.

Note. Show Slide 10.

f. **Result Presentation.** The TWGSS system has the following capabilities.

(1) **Numerical presentation.** This is used during exercises where immediate feedback is needed or desired.
(2) **Graphic presentation.** This is used for exercises where the presentation of the impact point in relation to the target outline is more important than numerical presentation.
(3) **Result presentation OFF.** When conducting gunnery training or combat mode (force-on-force) exercises where the crew should not see the results until after the exercise, the instructor can turn off the result presentation in the control panel. The results are still stored on the TDRS memory card for AAR.

g. **Results Provided by Control Panel.** The system provides both the results from engagements where a tank has fired or has been fired upon.

Note. Show Slide 11.

(1) **Fire result.** Elevation and azimuth impact point on the target is shown in relation to center of mass. The results are provided in meters with a resolution of 0.1 m. The aspect angle, type of round fired, and effect on the tank are also provided on the display screen.

Note. Show Slide 12.

(2) **Target result.** Elevation and azimuth impact point on the tank is shown in relation to the center of mass. The results are provided in meters with a resolution of 0.1 m. The aspect angle, type of round fired, and effect on the tank are also provided on the display screen.

Note. Show Slide 13.

h. **Engagement Result.** The control panel presents an evaluation of the engagement together with the actual hit coordinates and range to target. The following results are possible.

(1) **HIT**. The simulated round hit the target. The simulator assumes the target is either a T80 Frontal for a main gun round or a kneeling soldier for coax rounds. If the control panel indicates a HIT, a MILES code is sent to allow the LTID to function.

Note. MILES codes used for TWGSS are IAW the enhanced MILES code structure.

(2) **GROUND HIT.** A ground hit occurs if the ammunition falls short of the maximum range simulated for that ammunition type or falls short of the target. A ground hit is presented with the range of the actual ground impact.

(3) **MAX RANGE.** If maximum range is indicated on the control panel, the round fired did not pass a target with a retro reflector unit within the field of view of the transceiver unit.

I. **Sound Indications.** The system uses sound to indicate to the crew that different events have taken place. The sound indications can be divided into firing system and target system sound indications.

Note. Show Slide 14.

(1) **Firing system sound indications.** For the loading and firing of ammunition the following sound indications are heard through the tank intercom:

(a) The opening of the ammunition door. This occurs when the loader presses the loader's panel to load ammunition.

(b) The closing of the breech block. This indicates to the crew that the round is chambered and ready to be fired.

(c) The main gun firing and the AFTCAP falling from the breech. This indicates to the crew that a round has been fired.

(d) The firing of the COAX.

Note. Show Slide 15.

(2) **Target system sound indications.** When a TWGSS system is fired, the tank intercom indicates to the crew the following:

(a) NEAR MISS = 2 tones. If the tank had a near miss, the tank intercom indicates with 2 tones.
(b) HIT (no kill) = 4-6 tones. If the tank is hit by a round but not killed, the tank intercom indicates with 4-6 tones.

Note. WEAPON KILL and MOBILITY KILL are also indicated with 4-6 tones.

(c) KILL = continuous tone. If the tank is hit and killed, a continuous tone for 30 seconds is heard in the tank intercom. A kill tone is also indicated if CGUN KILL is transmitted to the tank.

Notes. 1. In combat mode, a killed tank is reactivated with the CGUN. The tank ammunition load is returned to the pre-programmed load.
2. If the tank is killed during panel gunnery, the target system autoactivates after 10 seconds and the kill indications stop. The tank ammunition load is returned to the pre-programmed load.

j. **Target System Visual Indications.** Target system effects are indicated by the strobe lights in the retro detector unit (RDU). The following visual indications are given by the target system:

Note. Show Slide 16.

(1) **NEAR MISS = 2 strobe light indications.** If a target is exposed to a near miss, the RDUs will flash two times with the strobe light of each RDU.
(2) **HIT = 4-6 strobe light indications.** If a target is exposed to a hit, the RDUs will flash 4-6 times with the strobe light of each RDU (360 degrees coverage).

Note. WEAPON KILL and MOBILITY KILL are also indicated with 4-6 strobe indications.

(3) **KILL = continuous strobe light indication.** If the target is killed by a round or a CGUN, the RDUs will flash continuously. This indication will continue until the system is reactivated.

Notes. 1. If the tank is killed during panel gunnery, the target system autoactivates after 10 seconds and the kill indications stop. The tank ammunition load is returned to the pre-programmed load.
2. Show Slide 17.

6-2. CONFERENCE/DEMONSTRATION/PRACTICAL EXERCISE (Con't).

k. **Target System HIT Functions.** TWGSS can simulate three different types of tank hits. It is important the crew reacts properly to each type.

Note. During force-on-force exercises, the tank commander must take the correct action for the type of hit indicated on the control panel.

(1) **HIT.** The tank has been hit but not damaged or killed, therefore it can continue to fight.

Note. MOBILITY KILL will only be indicated if the tracks are hit.

(2) **HIT with MOBILITY KILL.** The tank has been damaged and immobilized. If a mobility kill is indicated, the crew must stop within 30 seconds or the tank will be killed. During a mobility kill, the crew can continue to engage targets from a stationary position.

Note. WEAPON KILL will only be indicated if the gun barrel or sights are hit.

(3) **HIT with WEAPON KILL.** The tank has been hit by a round and the weapon system has been damaged. The tank can still maneuver but cannot fire the main gun or coax.

(4) **KILL.** The tank has been hit and the target system evaluates the round to have killed the tank. The vehicle must be stopped (when the crew considers this action safe) and they must wait for further instructions.

Note. Show Slide 18.

l. **Tamper During Combat Mode (Force-on-force) Exercises.** If TWGSS is tampered with or if something breaks down, this will be indicated as tamper to the crew. The crew has 30 seconds to correct the failure on the system. If not corrected, TWGSS will consider itself Not Mission Capable (NMC) for a force-on-force exercise. The following tamper indications are provided:

(1) **Sound indication.** The tank intercom informs the crew to check the control panel.

(2) **Tamper pop-up.** A tamper pop-up appears on the display screen to inform the crew that there is something that must be corrected.

(3) **Visual indication.** The retro detector units of TWGSS indicate with flashes if something is incorrect.

6-2. CONFERENCE/DEMONSTRATION/PRACTICAL EXERCISE (Con't).

Note. Show Slide 19.

m. **Tamper During Panel Gunnery Exercises.** If TWGSS is tampered with or if something breaks down, this is indicated as a BIT error to the crew. A BIT indication removes the capability to fire until corrected. The following indications are provided:

(1) **Sound indication.** The tank intercom informs the crew to check the control panel.
(2) **BIT pop-up.** A error pop-up will appear on the display screen to inform the crew that there is something wrong with the system.
(3) **Visual indication.** TWGSS RDUs will indicate with flashes if something is incorrect.

Notes.
1. The primary instructor now releases the student crews to their assigned assistant (small group) instructors for the practical exercise portion of this lesson.
2. Prior to students' arrival, ensure that an assistant instructor is assigned to each training station.
3. Direct students to their appropriate training station.
4. Each assistant instructor is to conduct a safety briefing for his small group IAW Appendix B.
5. Whenever possible, have the students serve as demonstrators during small group instruction. Have one student read the procedures while another student performs the task. To ensure all students get equal hands-on time, rotate the reading and performance responsibilities.
6. The assistant instructor discusses and clarifies the procedures as required and reinforces the training objective.
7. Ensure training area is set up IAW Appendix D for each training mode selected.
8. Ensure TDRS memory card is set up IAW Appendix C for each training mode selected.

Warning. The moving and operation of tank during the practical exercise portion of this lesson must be done under the instructor's supervision.

Notes.
1. Instruct the crew on how to transfer ammunition using the upload function in the control panel when ready rack ammunition is depleted.
2. The instructor can replenish ammunition loads with the RESET setting on the CGUN.

n. **TWGSS Operation.** TWGSS can perform gunnery in four modes: panel gunnery; combat mode; scaled gunnery mode; and tracking training mode.

(1) **Panel gunnery mode.** Fire on target and verify the following:

Warning. Ensure LRF eye-safe laser (ELF) filter is installed prior to selecting tank LRF.

(a) Select tank as rangefinder using control panel.
(b) Lase to target and verify that correct range appears in sights.
(c) Lase in front of target and verify that a range of 190 m for main gun and 10 m for coax is presented in sight.
(d) Lase over target and verify that a range of 4010 m for all ammunition types is presented in sight.
(e) Fire SABOT from all sights and verify obscuration, ground burst, hit burst, and tracer.
(f) Fire HEAT from all sights and verify obscuration, ground burst, hit burst, and tracer.
. (g) Fire COAX from all sights and verify ground burst, hit burst, and tracer.
(h) Fire all ammunition types and verify results on control panel are understood.
(i) Select graphic display. Fire all ammunition types and verify result presentation.
(j) Verify ammunition is decreased when a round is fired.
(k) Verify TWGSS loading and firing sound indications.
(l) Use a CGUN to fire KILL, RESET, TEST, and TIME MARK on tank and verify control panel menus, sound, and light indications.
(m) Fire ENABLE CONTROL with CGUN. Upload ammunition manually to turret and hull.
(n) Select display position. Verify control panel displays vehicle position as determined by the remote system interface (RSI).
(o) Unplug left front RDU. Verify control panel tamper indication. Try to fire.

Notes. 1. Ensure that TDRS memory card is set up for combat mode IAW Appendix C.
2. Position target tanks for combat mode IAW Appendix D.
3. Use the CGUN to activate target tank if killed.

(2) **Combat mode.** Fire on target and verify the following:

Note. Point out to students that during combat mode TWGSS compensates for the retro reflector unit position.

(a) Select Simulation (SI), Remaining Ammo (RM). Fire SABOT at TWGSS-equipped target vehicle. Aim at center of mass and verify that system compensates for retro reflector offset in combat mode (result is approximately 0.0 in. elevation and azimuth).
(b) Verify target NEAR MISS, HIT and KILL visual indications.
(c) Have target vehicle crew cover all hull defilade detector units (HDDUs) exposed to firing tank. Fire into hull and verify that vehicle is not killed.

Caution. Do NOT use force when connecting or disconnecting cables.

Note. During tamper demonstration, disconnect RDU for less than 30 seconds and then longer than 30 seconds to demonstrate tamper kill.

(d) Disconnect left-front RDU. Verify control panel indications.
(e) Verify that it is impossible to fire when no rounds remain.
(f) Upload ammunition using Remaining Ammo menu. Select SABOT and move ammo from hull to turret. When completed, verify that SABOT can be fired.
(g) Have the another vehicle fire at you to verify NEAR MISS, HIT, and KILL indications on control panel, tank intercom, and strobe lights.
(h) Position tank so the tracks can be hit. Have firing vehicle fire at track and check for MOBILITY KILL in target tank.

(3) **Tracking training mode.** Tracking training exercises can be performed in panel gunnery mode against targets with retro reflectors installed in center of mass, or in combat mode against targets with turret-installed retro reflector units.

Warning. Ensure that LRF eye-safe laser filter (ELF) is installed during all TWGSS training.

(a) Tracking training mode requires that the vehicle be set up differently than normal gunnery training. During tracking training, TWGSS measures the gunner's aim in relation to the target. When the trigger is pressed, the gunner's tracking result is stored on the TDRS memory card for After Action Review (AAR). To correctly measure the gunner's aim point, the vehicle must be set up as follows.

1. Input the following computer correction factors using the gunner's control and display panel (GCDP).

Ammunition	Subdesignation	Azimuth	Elevation
SABOT	59 (MILES trainer)	0.0	0.0
HEAT	59 (MILES trainer)	0.0	0.0
COAX	59 (MILES trainer)	0.0	0.0

2. Input the following ballistic data using the gunner's GCDP.

a. Set cant sensor to auto selection mode.
b. Set lead button to OFF.
c. Set range to normal operation.
d. Set cross wind sensor value to 0 mph and select MANUAL mode.
e. Set ammunition temperature to 70° F.

f. Set air temperature to 59° F.
g. Set barometric pressure to 29.92 in. of mercury.
h. Set PITCH/ROLL to ON position.
i. Set hull/turret (H/T) sensor to ON position.
j. Confirm turret/hull alignment.
k. Set coax boresight values the same as boresight values for main gun.
l. Set coax zero to elevation 0.0 and azimuth 0.0.

(b) Perform normal alignment procedures, but do not perform TBOS alignment for GAS or GPS gunner/commander. The TBOS effects will be turned OFF during tracking training exercises.

Select SIMULATION, LASER RANGEFINDER menu on control panel and select TANK LRF.

Notes. 1. Prior to start of the training exercise, ensure that the TDRS memory card has been properly set up for tracking training IAW Appendix C.
2. Prior to the start of the training exercise, prepare a HMMWV with retro reflector units installed on center of mass. Instruct driver to drive a parallel path approximately 600 m away.

(c) Operation of tracking training mode.

1. Load a round and select main or coax.
2. Arm the weapon.
3. When gunner's or commander's palm switch is pressed, tracking data collection is started.

Note. Inform students that trigger activation will provide the tracking result which is stored on the TDRS memory card for AAR.

4. Tracking data is collected until one of the following events occurs:

a. The gun trigger is activated for firing main gun or coax.

Note. Inform students that if the tracking time elapses, no tracking values will be stored on the TDRS memory card for AAR.

b. The tracking time has elapsed. (Time is selected prior to exercise by instructor).

6-2. CONFERENCE/DEMONSTRATION/PRACTICAL EXERCISE (Con't).

Note. Inform students that if the palm switch is released, no tracking values will be stored on the TDRS memory card for AAR.

c. Gunner's or commander's palm switch is released.

5. Set the SAFE/ARM switch to SAFE.

Note. Demonstrate AAR of tracking training to the students on the TDRS computer unit.

6. Repeat tracking training exercise by starting at step (c) 1.

Notes. 1. Have students practice tracking training against a moving target.
2. Evaluate tracking training exercise using the TDRS computer unit.

6-3. FINAL REVIEW. (5 minutes)

a. **Student Questions.**

Note. Show Slide 20.

b. **Summary of Main Teaching Points.**

(1) Panel gunnery
(2) Combat gunnery (force-on-force)
(3) Tracking training

Note. Show Slide 21.

c. **Closing Statement.** To get the maximum training value from the TWGSS equipment, you must be able to correctly operate the system in the various training modes.

APPENDIX A
TO LESSON PLAN 6

OPERATION OF TWGSS

TOOLS, EQUIPMENT, AND MATERIALS

Listed equipment is one per tank crew, except as noted.

1. M1A2 tank with TWGSS installed
2. TM 9-6920-709-12&P-1-2
3. T80 frontal target with target lifter placed at 1500 m
4. T80 frontal target with target lifter placed at 800 m
5. Infantry (coax) target placed at 300 m
6. Retro reflector unit (one for each target used)
7. LTID (one for each target used, if available)
8. TDRS memory card, programmed IAW Appendix C
9. TDRS computer unit (one per class)
10. Training area with a minimum of 1500 m of maneuver space
11. HMMWV with retro reflector unit installed on left and right side center of mass

APPENDIX B
TO LESSON PLAN 6

OPERATION OF TWGSS

SAFETY

Listed general safety regulations are to be strictly enforced during the performance of this lesson.

1. Mount and dismount tank over left front fender.
2. Maintain three points of contact while on top of tank.
3. No smoking within 50 m of tank.
4. Do not go over or under gun tube.
5. Ensure LRF has eye-safe laser filter (ELF) installed and LRF is set to SAFE.
6. LASER SAFETY: Do not view transceiver unit with optics from a distance of 25 m or closer.
7. Ensure proper hearing protection is worn when using pyrotechnics.
8. When using pyrotechnics (Hoffman device), ensure area is clear 50 m to the front and 25 m to the sides.
9. Ensure gun/turret drive (GTD) switch is set to MANUAL position during installation/removal, alignment, troubleshooting, and before leaving turret.

APPENDIX C
TO LESSON PLAN 6

OPERATION OF TWGSS

TDRS MEMORY CARD SETUPS

The TDRS memory card used for the practical exercise portion of this lesson is set up with the following basic data. Each tank crew is provided a card prior to the lesson.

C-1. SETUP FOR PANEL GUNNERY.

Application:	M1A2
Exercise Area:	Select exercise area used
New Ammo:	Yes
First Insert Only:	No
Main Weapon:	
SABOT Turret:	11 rounds
HEAT Turret:	6 rounds
SABOT Hull:	15 rounds
HEAT Hull:	8 rounds
Load Time:	6 seconds
Upload Time:	60 seconds
COAX Rounds:	
7.62 Turret:	11400 rounds
7.62 Hull:	0 rounds
Upload Time:	- seconds
Exercise Type:	Panel gunnery
Tracer:	
Tracer On:	Yes
Burst On:	Yes
Obscuration:	1 second
Presentation:	
Audio:	Yes
Control Panel Presentation:	Yes
Firing:	Full scale
Dispersion:	No
User Data:	Input crew data

C-2. SETUP FOR COMBAT MODE (FORCE-ON-FORCE).

Application:	M1A2
Exercise Area:	Select exercise area used
New Ammo:	Yes
First Insert Only:	No
Main Weapon:	
SABOT Turret:	11 rounds
HEAT Turret:	6 rounds
SABOT Hull:	15 rounds
HEAT Hull:	8 rounds
Load Time:	6 seconds
Upload Time:	60 seconds
COAX Rounds:	
7.62 Turret:	400 rounds
7.62 Hull:	0 rounds
Upload Time:	- seconds
Exercise Type:	Combat mode
Tracer:	
Tracer On:	Yes
Burst On:	Yes
Obscuration:	1 second
Presentation:	
Audio:	Yes
Control Panel Presentation:	No
Firing:	Full scale
Dispersion:	Yes
User Data:	Input crew data

C-3. SETUP FOR TRACKING TRAINING.

Application:	M1A2
Exercise Area:	Select exercise area used
New Ammo:	Yes
First Insert Only:	Yes
Main Weapon:	
SABOT Turret:	11 rounds
HEAT Turret:	6 rounds
SABOT Hull:	15 rounds
HEAT Hull:	8 rounds
Load Time:	5 seconds
Upload Time:	60 seconds
COAX Rounds:	
7.62 Turret:	400 rounds
7.62 Hull:	0 rounds
Upload Time:	- seconds
Exercise Type:	Panel gunnery
Tracer:	
Tracer On:	No
Burst On:	No
Obscuration:	0 seconds
Presentation:	
Audio:	No
Control Panel Presentation:	No
Firing:	Tracking
Tracking Time:	10 seconds/1.0 mil
Dispersion:	No
User Data:	Input crew data
Event:	Tracking Training

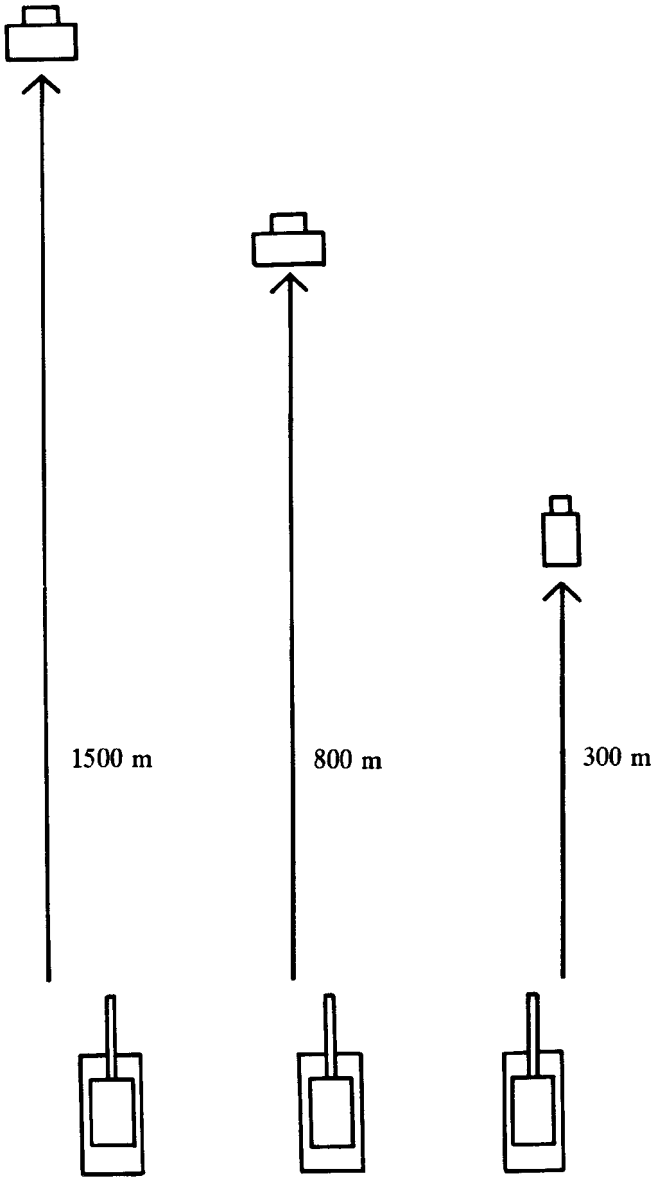
APPENDIX D
TO LESSON PLAN 6

OPERATION OF TWGSS

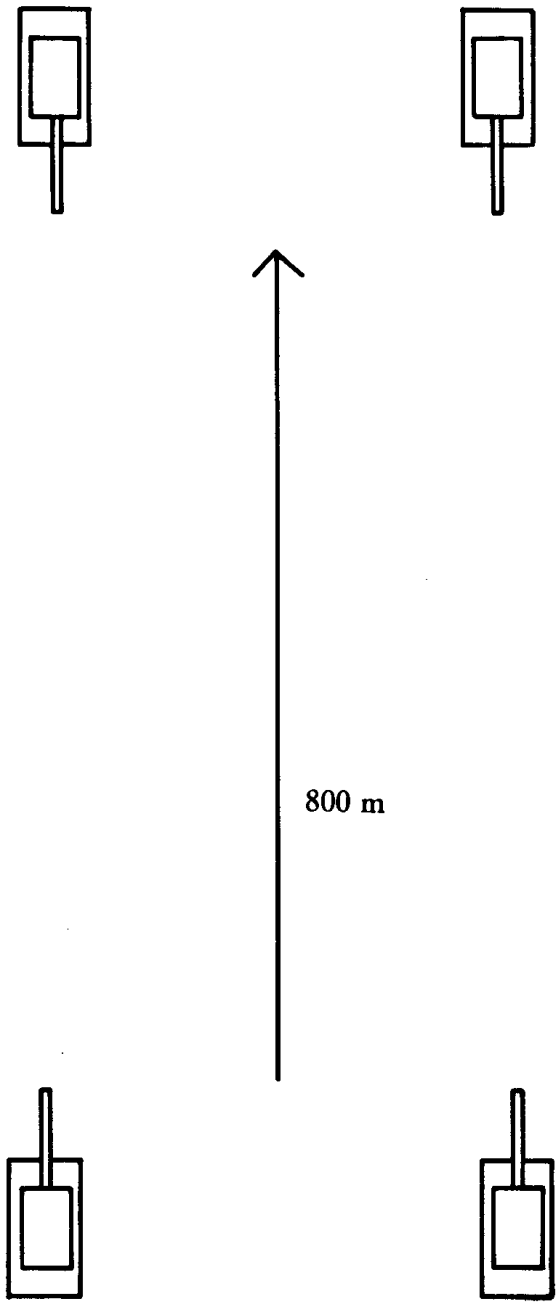
SETUP OF TRAINING AREA

D-1. PANEL GUNNERY.

This target emplacement can be used for full range panel gunnery and scaled gunnery.



D-2. COMBAT MODE (FORCE-ON-FORCE).



APPENDIX E
TO LESSON PLAN 6

OPERATION OF TWGSS

VIEWGRAPHS